simultaneous movement in July, 1880, together with the simultaneous movement of October, 1880.

If this be a correct analysis of the curves, then there is the remarkable fact to be noted, that the motion of these waves in a westward direction takes place at an average rate of two and a half months, that is to say, twice as rapidly as in the eastward direction. And this fact would readily accord with the supposed westward lagging of the atmosphere due to its inertia; and also with any supposed influence of the sun. The presence of this westward transmission is not so apparent, however, as that of the eastward. And whether it be present or not, there still remains the difficulty, substantially the same as at the outset, that the motion eastwards is by far the most defined and most readily traceable; a difficulty for which I cannot even guess at any solution. Facts, however, should not be overlooked because they cannot be explained, but rather an explanation sought; and in the explanation of this fact theoretical matters of considerable interest may perhaps be involved. The only hints at any facts which might by any possibility suggest an explanation are to be found in Mr. Chambers's summary of his discovery, where he speaks of the direction eastwards being like that of "the cyclones of extra-tropical latitudes"; and in the very interesting and more suggestive statement of Dr. Balfour Stewart (*vide* NATURE, vol. xxii. p. 151), in which he says, speaking of terrestrial magnetism, "that we have some evidence which leads us to suspect that particular states of declination range, like particular states of weather have a motion from west to east, the magnetical moving faster than the meteorological."

As to the cause of these widely-distributed simultaneous movements of the barometer, movements which I consider to be in the main the initial impulses of the complication of abnormal movements visible in the curves, I have no evidence of any value. The most natural idea is that a connection, direct or indirect, may be traced between them and changes in the state of solar energy; the downward movements perhaps being due to an excess of energy, and the upward movements to a deficiency. In some points, perhaps, they may bear analogy to magnetic storms. I have not a sun-spot curve for the years under consideration, and cannot therefore make the necessary comparisons.

As a working hypothesis to serve as a guide in further investigating the matter, I should be inclined to suppose that the atmosphere, if it could, without stopping the earth's motion, be divested of its regular diurnal and seasonal movements, and the eddies and storms resulting therefrom, would present to observation a somewhat intricate mixture of motions consisting of the following elements:—

1. Certain initial movements, resulting mediately or immediately from changes in the state of the sun's energy, and affecting very wide areas, and being of the form of heapings up or drawings away of the atmosphere over these areas, the movements attaining their maximum height or depth at the centre of these areas. The centres of these areas would be immediately under the sun, that is to say, within the tropical latitudes.[1]

2. Waves resulting from the propagation in eastward and westward (and perhaps, though in a less marked degree northward and southward) directions of the impulses given by the first movements; the waves which travel eastward being for some unexplained reason more pronounced than those travelling westward, but their rate of motion over the earth's surface being, on account of the rotation of the earth and the atmosphere's inertia, slower in the eastward direction than in the westward.

3. Small local movements over more limited areas resulting from the chance conjunction and interference of any two or more of the first and second movements.

An extensive and detailed examination of the barometric records of stations scattered over the globe will bring to light facts either favourable or unfavourable to this hypothesis; and after this examination has been made, it will then be time to decide whether or not it is worth while undertaking the labour of dealing with the subject mathematically.

The matter seems important even theoretically, for in it and investigations of a like kind are to be found attempts at a rational arrangement of the very complex collection of facts contained in the various records of barometric abnormal movements; and practically also, for on the results of further investigation into it depends the confirmation or dismissal of a hypothesis which has given promise of furnishing a useful method of weather forecasting.

A. N. PEARSON,
Acg. Meteorological Reporter for Western India

Bombay, January 10

[1] Mr. H. F. Blanford's discovery of "a barometric see-saw between Russia and India in the sun-spot cycle" (*vide* NATURE, vol. xxi. p. 477) seems to support this hypothesis.

SCIENCE IN RUSSIA

THE Kieff Society of Naturalists was opened in 1869, and soon had more than a hundred members, mostly belonging to the University. Like other Societies of Naturalists at the Russian Universities, its chief aim has been the exploration of Russian natural history in the neighbouring provinces, these explorations proving that though the region around the Dnieper was not quite unknown in its geological, botanical, and zoological aspects, still there were wide lacunæ to be filled up before arriving at a thorough knowledge of it. Prof. Feofilaktoff, who had already published a geological map of the province of Kieff, assisted by several young geologists, busily explored, therefore, the surrounding provinces, especially on the right bank of the Dnieper, and published in the *Memoirs of the Kieff Society* a series of valuable papers on the Cretaceous, Tertiary, and post-Tertiary of the region, as well as on brown coal on the Dnieper. The Phanerogamic flora of the Dnieper region being sufficiently well known from the former works of Professors Andrzeiovski, Trautvetter, Rogowicz, and several others, the chief attention of the Society has been devoted to the Cryptogamic flora; and numerous papers by MM. Borschoff, Plutenko, Wältz, Rishavi, Timofeeff, Ryndovsky, Moshinsky, and Sovinsky, on the algæ, mosses, lichens, and fungi of the Dnieper region, as well as of Caucasus, appeared in the *Memoirs*. In zoology the chief researches were directed towards the exploration of the invertebrate fauna of the Black Sea, and whilst M. Bobretzky thoroughly studied the Annelids of the Black Sea, M. Krichaguin carried out special studies of the Copepoda, and M. Paulson studied the Crustaceans of the Red Sea, in order to compare them with those of the great interior sea of Russia and Turkey. Several valuable papers were published at the same time on the anatomy and physiology of animals and plants, whilst the researches in chemistry and physics which were made at the Kieff University were mostly sent for publication to the *Journal of the Russian Chemical and Physical Society* at St. Petersburg.

Finally, the Kieff Society has undertaken, since 1873, the yearly publication of a most valuable systematic catalogue of papers in mathematics, in natural science, pure and applied, and in medicine, published throughout Russia in the numerous scientific publications which have grown up during the last ten years. These catalogues, which have reached during the last few years the size of large octavo volumes two hundred pages in extent for natural sciences and the same for medicine, are most valuable, as the number of provincial publications rapidly increases in Russia, and scientific papers of great value are virtually buried among the publications of the statistical committees, provincial assemblies, local scientific societies, and so on. The last (tenth) volume of this catalogue contains an index for the whole series of ten volumes.

The two last volumes of the *Memoirs* (*Zapiski*) *of the Kieff Society of Naturalists* (vols. v. and vi. 1879-1882) contains, like the preceding ones, a good many valuable papers. In geology we find several papers by Prof. Feofilaktoff and Schmalhausen. According to the former, the Eocene formation of the region has its central parts in the Government of Kieff, on the banks of the Dnieper. It consists of two series of deposits, the sandstones and sands of Traktemiroff, which only contain remains of Mollusks; and the Spondylus deposits which cover the former, and consist of sands, Spondylus clay, and greenish sands with plants (vol. v. fasc. 2). These plants, according to M. Schmalhausen's researches, which will soon be published by the Society, are the Alga *Chondrites*, similar to the Eocene *Chondrites Targionii*; a Conifer similar to the *Araucarites Duchartrei*; fruits of *Nipadites*, similar to those of the London clay; and pieces of Coniferæ and Palms and of a Bromelite (*Br. Dolinskii*, Schmalh.), fruits of tropical Leguminosæ (*Leguminosites Rogowiczi* and *L. Feofilaktowi*), and leaves of *Ficus prisca*. All these plants have been found in the upper parts of the clay, whilst in the sands that cover it M. Schmalhausen found a great number of stems and leaves of marine Monocotyledons, such as *Caulinites Rogowiczi* (a new species akin to the *Caulinites parisiensis*), and a new species of *Zorterites*, as well as parts of a new species of Graminea, *Polocapyrum incertum* (vol. vi. *Pro-*

ceedings). In another paper Prof. Feofilaktoff gives a description of the diluvium of Poltava (vol. vi. fasc. 1). It consists of three different series of deposits, namely, the lower boulder clay, the loess, and the upper boulder deposits. The yellow loess of Poltava is a quite characteristic loess, and contains the usual *Helix hispida*, *Pupa muscorum*, and *Succinea oblonga*, but it is well stratified at certain places, as it contains intermediate deposits of sandy clay. The upper boulder clay reaches a thickness of forty to fifty feet, and contains boulders five to ten feet in diameter. It consists of materials brought from the north, with a mixture of local materials—chiefly of the underlying loess—without any kind of stratification of the different elements of which it consists. M. Schmalhausen gives a description, with a plate, of the stem of the *Protopteris punctata*, Sternb., from the Government of Volhynia. This sample seems to be the best known up to the present time, and M. Schmalhausen doubts whether this cretaceous fern has been found anywhere in Western Europe in so well-preserved a state. The incomplete samples which were often found in Western Europe led to its being described under the names of *Filicites punctatus*, *Sigillaria punctata*, *Caulopteris punctata*, and *Protopteris Sternbergi*. A note by Prof. Borschoff, on the downs of the Kyzyl-Koum Steppe, has been previously noticed in these columns. We notice also several analyses of Caucasian mineral waters.

The zoological papers are numerous and important. M. Krichaguin gives an account of his dredgings on the north-eastern coast of the Black Sea, and describes the following new species of Copepoda: *Monstrilla intermedia*, *Monstrilla pontica*, *Longipedia pontica*, *Tachidius Abrau*, *Canthocampus æquipes* and *longicaudatus*, *Liljeborgia pontica*, *Cleta brevirostris armata*, *C. Thalestris*, and *C. Liljeborgia*, *Westwoodia pontica*, *Thalestris filifera*, and *Oithona minuta*. His conclusions are: that the fauna of the Black Sea has great originality, owing to the large number of original genera it contains; that the cosmopolite forms either appear as original species, or have a resemblance to the Mediterranean ones, and that those species which are common to the Black Sea and northern seas have undergone important modifications (vol. v. fasc. 1). M. Sovinsky's paper on the Amphipods of the Bay of Sebastopol (vol. vi. fasc. 1) contains a complete monograph of the twenty-seven species he has found in this bay, and a description of four new species of *Sunamphitoë*, *Dexamine*, and *Microdeutopus*. Another paper by the same author (vol. vi. fasc. 2) contains a comparison, with plates, of the Red Sea species *Virbius proteus*, as well as the genera *Nikoides* and *Alpheodes*, established by M. Paulson, with the Black Sea forms *Virbius gracilis*, Hell., *Nikoides pontica*, and the Mediterranean *Alpheus dentipes*, which are nearly akin to the above. M. Bobretzky, who published, in 1870, in the *Memoirs of the Kieff Society of Naturalists*, a systematic description of forty-three species of *Annelida Polychæta*, has recently revised his determinations on the ground of new observations, as well as of the researches by MM. Claparède and Marion; and, without seeking to establish new species, he has preferred to establish a comparison between the Black Sea and Mediterranean forms, and to maintain only the three following new species: *Polynoë incerta*, *Ophelia taurica*, and *Terebellides carnea*.

In the department of comparative anatomy we notice an elaborate paper by M. Rumshewich, on the development of the eye among Vertebrates, accompanied by numerous plates; on the internal muscles of the eye of Reptiles (*Lacerta agilis*, *L. viridis*, *L. Stirpium*, *Chelonia fluviatilis*, and *Ch. midas*), by the same; on the reproductive organs in Annelids, and on the origin of the blastoderm in insects, by M. Bobretzky; and on the structure of the brain in man, by M. Betz.

Botany is represented in volumes v. and vi., only by lists of Phanerogams and of Algæ in the district of Radomysl, on the Teterev River, by M. Sovinsky; and chemistry by an elaborate paper, by M. Barzilovsky, on the nitrotoluols.

After having largely contributed during the years 1855 to 1865 to the purely geographical exploration of the unknown parts of Siberia and the adjacent countries, the East Siberian branch of the Russian Geographical Society entered upon a period of more thorough scientific exploration of Siberia itself. The merely geographical expeditions, such as that of MM. Czekanovski and Müller to the land of the Chuckches, became few and rare, and we now find the members of the Society engaged in a complete exploration of the natural history of Siberia, so that the two last volumes of the *Izvestia*[1] of the East Siberian branch bring us a series of researches into the geology and anthropology of Siberia. The first rank among these undoubtedly belongs to the geological explorations around Lake Baikal, by M. Chersky. The young geologist of Irkutsk publishes for the first time a most interesting geological map of the coasts of Lake Baikal. It appears from this map that the great mass of the mountains on the western shore of the lake consists of Laurentian crystalline slates, mostly chloritic schists and gneisses, overlying the aphanite schists and amphibolitic slates, with intercalations of granites, granito-syenites, and porphyries. The upper horizon of the same formation consists of the same slates and gneisses, with thick intermediate deposits of limestones. The whole is covered to the west with Silurian deposits, a large Jurassic freshwater basin occupying the depression of Irkutsk. Smaller depressions are occupied by freshwater Miocene deposits. The most important result of M. Chersky's researches is that (as was foreseen on the ground of orographic and architectonic data) the depression of Lake Baikal is not a longitudinal valley, as might be supposed at the first aspect. The chains of mountains we see on its western shore reappear on the eastern shore, maintaining the same direction from south-west to north-east, and *crossing* the lake in the shape of submerged low ridges. On the south-eastern shore of Lake Baikal M. Chersky found the continuation of the high plateau of Eastern Siberia consisting of the same two parts of the Laurentian formation, and covered with lower Silurian deposits, the depressions of which were occupied during the Tertiary period with freshwater lakes; there are also numerous traces of great lakes which covered wide tracts during the Post-Glacial period. As to the glacial period, the number of accurate observations published by the East Siberian geologists is unfortunately not in proportion to the amount of theoretical discussion, the only sure and new facts we have to mention being the presence of *roches moutonnées*, due to glaciation, on the northern shore of Lake Kossogol, that is, on the high plateau at the foot of its border-ridge, the Sayan Mountains (they were described by the late M. Czekanovski); traces of glaciation in the higher parts of this ridge; polished *roches moutonnées* at several places of the high plateau in the basin of Selenga, requiring, however, a more careful examination; and glacial deposits in the valley of the Irkut, due to local glaciers, whose extremities reached a height of less than 2000 feet above the present sea level.

The Siberian branch of the Geographical Society has taken, during the last few years, a lively interest in anthropology and archæology, and we notice in the two last volumes of its *Izvestia* a series of papers on this subject. M. Vitkovsky's excavations of grave-mounds of the Stone period on the left bank of the Angara, at the mouth of the Kitoy, and also of the sand-hills which were inhabited by prehistoric man, have yielded a very rich collection of bones and implements. No less than twenty complete skeletons were dug out, twenty-five nephrite hatchets, numerous nephrite, jade, and quartzite arrow-points, bone needles, and implements for fishing. The most interesting feature of these implements is the presence in very great numbers of carved pieces of slate, pretty well polished, and representing seals. They occur in large quantities (160 in M. Vitkovsky's collection), and are of all sizes, from 150 millimetres to 15 millimetres long. These carvings of seals, as well as other implements, are illustrated in the plates which accompany M. Vitkovsky's paper. The skulls testify that the inhabitants of the Downs were a mixture of dolichocephals and brachiocephals, the former seeming to have predominated. The jade of which the hatchets were made was probably taken from the jade boulders which are found in the valley of the Byelaya River in the Government of Irkutsk. We notice, also, most valuable papers by M. Agapitoff on the hieroglyphics on cliffs on the western shore of Lake Baikal; and on the remains of prehistoric man in the province of Irkutsk, and on Olkhon Island. The hieroglyphic inscriptions on cliffs which are so numerous in the district of Minusinsk (they were lately figured in the St. Petersburg *Izvestia* of the Geographical Society) were supposed to be very rare towards the east; but simply because they remained unknown. Those on Lake Baikal (reproduced in the Siberian *Izvestia*) represent several men, of two different sizes, reindeer, deer, birds, and, most probably, a horse with a man upon it. The old graves are very numerous, too, on Olkhon Island, and they belong (according to the measurements of the skull) to Mongolians, as well as the remains of stone walls which were discovered on the shore of Lake Baikal. They contain iron implements, as well as glass globules and amber pearls.

The Siberian branch of the Geographical Society has also,

[1] *Izvestia* of the East Siberian branch of the Russian Geographical Society, vols. xii. and xiii. Irkutsk, 1881 to 1883.

during the last few years, devoted much attention to the meteorology of Siberia, and, besides the meteorological observations made at its stations, it has collected materials for ascertaining the dates of the freezing and breaking up of the ice in Siberian rivers. The list of these dates for the rivers of Siberia for the years 1874 to 1880 will certainly be consulted with profit, as also several brief notes on amber in Siberia, on chemical analyses of salt from various salt lakes, and of coral from the Nerchinsk district, and from the banks of the Amur, as also other smaller notes.

EXPERIMENTAL RESEARCHES ON THE ELECTRIC DISCHARGE WITH THE CHLORIDE OF SILVER BATTERY[1]

THE authors recall that at the conclusion of the third part of their researches (*Phil. Trans.* for June 11, Part I. vol. clxxi.) they stated that they intended to make an investigation on the dark discharge, and the special conditions of the negative discharge; this paper contains a number of experiments, more especially on the latter subject, and also others intended to throw light on the general nature of the electric discharge through gases.

The first part of the paper describes some experiments made with vessels of different forms in order to ascertain whether the dimensions and shape of the vessel have any effect on the pressure of minimum resistance to the electric discharge. This was found to be the case; for example, with a residual air charge in a spheroidal vessel 7 inches (17·8 centims.) long, and 5 inches (12·7 centims.) diameter (Fig. 1), the pressure of minimum resistance was as high as 3 millims., 3947 M; while in a tube 22·5 inches (57 centims.) long, and 1·625 inches (4·1 centims.) diameter, it was only 0·69 millim., 908 M; again in a smaller tube 23 inches (58·4 centims.) long, and 0·75 inch (1·9 centims.) diameter, it was 1 millim., 1316 M. It is evident, therefore, that not only the dimensions of the tube, but possibly also the shape of the terminals, have an influence on the pressure of least resistance, and it is very probable that in the atmosphere, where lateral expansion is practically unlimited, the conditions of minimum resistance are different from those which exist even

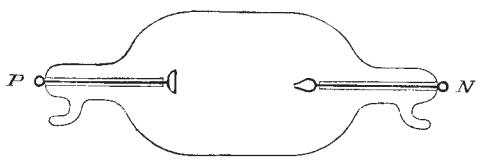

FIG. 1.

in very large tubes, and that this may influence the height of the aurora.

The paper next deals with the discharge in miniature tubes $\frac{7}{8}$ inch (2·2 centims.) long, and $\frac{1}{4}$ inch (0·63 centim.) diameter, with terminals nearly touching; at first it required 2400 cells to pass, then a single cell would do so, but after standing a short time it required 4800 cells to reproduce a discharge. In another tube $1\frac{3}{4}$ inch (4·4 centims.) long and $\frac{3}{8}$ inch (0·95 centim.) diameter), with the terminals distant 0·00104 inch (0·0264 millim.), it required 2240 cells to produce a discharge, then the potential had to be increased to 11,240 cells to do so. Ultimately even this number failed, but after the tube had lain by for some days 600 cells could pass. It is very possible that the strong discharge in the first instance volatilised a portion of the terminals which were of platinum, and that this volatilised metal condensed afterwards, or else that the terminals absorbed the gas so completely as to produce a vacuum too perfect to admit of a discharge taking place; and that ultimately sufficient of the occluded gas was again given off to render it again possible.

In connection with the occlusion of gas by terminals a case is described in which the terminals are of palladium and the charge hydrogen (Fig. 2). After a few discharges the terminals occluded some of the gas, and when a fresh one was produced a volatile compound of hydrogen and palladium was given off, especially from the negative, and produced a dense, mirror-like coating on the inside of the tube (Fig. 3); this was reoccluded by standing for a couple of days, leaving the tube free, and again given off to form a new mirror-like coating with a fresh discharge; this property has continued since March, 1875.

The paper next describes experiments to ascertain the length of the spark in dry air and in air saturated with moisture. It was found to be practically the same in both cases. With 10,860 cells the mean length of the spark between two paraboloidal points was found to be in dry air 0·45 inch (1·1 centims.), in moist air 0·447 inch (1·1 centims.).

The next subject taken up is the discharge in a tube from two batteries, first in the same and then in contrary directions. In the tube are two terminals at each end, one pair at opposite ends being inclosed in two short pieces of tube 9 inches (22·8 centims.) long and $\frac{1}{2}$ inch (1·27 centims.) diameter; the main tube being 31 inches (95·2 centims.) long and $1\frac{3}{4}$ inch (4·4 centims.) diameter. The various phases of the stratified discharge are represented in an engraved mezzotint steel plate copied from photographs, and show the effect of the one stratified discharge on another stratified discharge produced by a second battery. It is seen that two discharges in contrary directions may take place in the same tube, and that the one modifies the aspect of the other.

Experiments are also described in a tube in the form of a cross with four arms at right angles (Fig. 4), with two separate batteries connected in various ways with the different members.

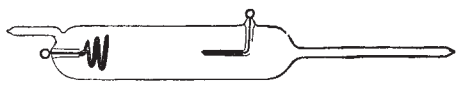

FIG. 2.

The experiments were made both in air and in hydrogen. By the introduction of external resistance of one of the batteries, the discharge could be readily identified as belonging to that battery by the effect of the resistance on the character of the stratification. In one of the mezzotint plates are several figures copied from photographs which show clearly the phenomena produced. Calling the poles P and N of one battery, A, and P′ and N′ of the other, B, it is shown in one case when two currents were equal 0·0083 ampere, that a discharge from A battery goes from P in the direction of N only so far as the junction at the cross, and then turns off to N′, the negative of the other battery B; while, on the other hand, the discharge of the B battery goes from P′ to N of the A battery. The case is different if an external resistance is introduced in one of the discharges, reducing it to 0·00087 ampere, then the discharge of the A battery goes from P to N, and that of the B battery from P′ to N′. There is a bending down, however, of the strata of the weaker discharge of the cross junction, in consequence of the action of the stronger one.

The authors remark that one cannot but be impressed, from the experiments described in the paper, and others in their former papers, by the apparent plasticity of the aggregate assem-

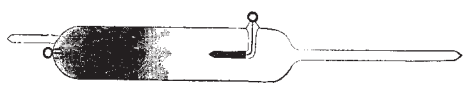

FIG. 3.

blage of molecules constituting a stratum which yields to external influences that modify its form.

The authors describe and figure a case of complex strata in the form of an outer bracket convex towards the negative (Fig. 5), and close to it an inner chord; also discharges in various gases in tubes of large dimensions, 37 inches (94 centims.) long, and $5\frac{13}{16}$ inches (14·8 centims.) diameter. In these the stratification, which is comparatively narrow at the terminals, extends in a conical form from the terminals to the full diameter of the tube.

They have found that the dark space in the discharge in vacuum tubes is only relatively actinically dark in comparison with a stratum, and they succeeded in obtaining a photograph of the dark space in thirty-five minutes as strong as that from a stratum in two and a half seconds; consequently they conclude that the dark space is 840 times less actinically bright than a stratum.

The authors next describe a number of experiments, by means of a Thomas-Becker electrometer used on a method, to avoid leakage, proposed to them by Prof. Stokes, to ascertain the difference of potential in different parts of a vacuum tube having a number of rings sealed within it, also in other tubes of special construction. These bring out instructive information, in reference not only to the relative resistances of different lengths of a

[1] Abstract of a paper read at the Royal Society on June 14, by Warren De La Rue, M.A., D.C.L., F.R.S., and Hugo W. Müller, Ph.D., F.R.S.